Universidad Popular del Cesar

Reconocimiento de Patrones

Version 2024-I

Carácterísticas Geométricas

[Capítulo 2]

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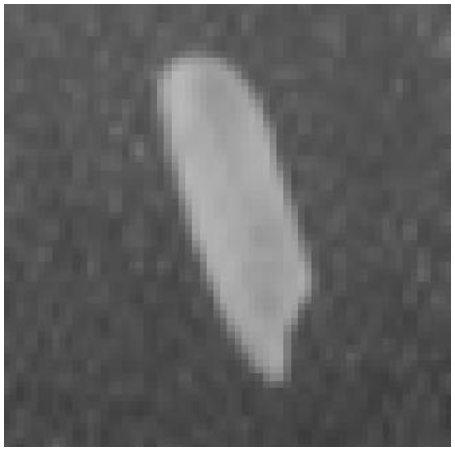
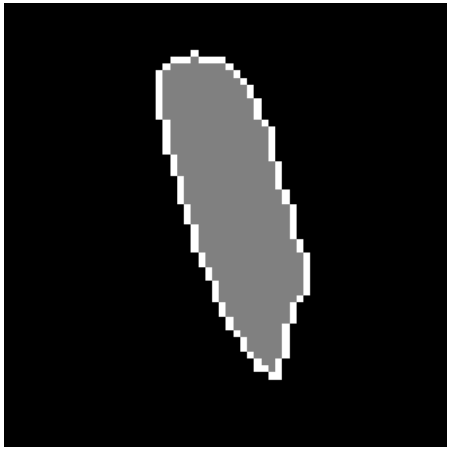
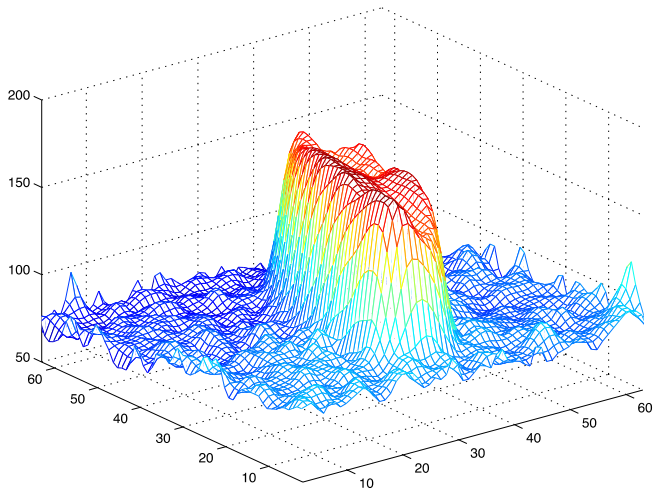






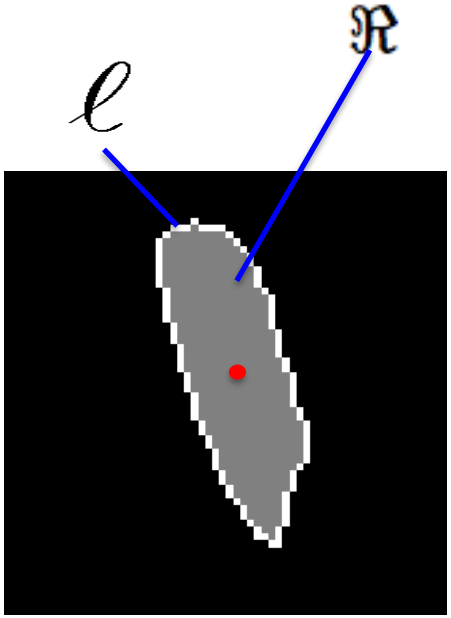
a) Grayscale image b) Segmentation c) 3D representation of a)

There are two categories of features: Geometric Features and Intensity Features

Geometric Features give information about location, orientation, shape and size.

Intensity Features give information about how are the grayvalues.

Geometric Features



Area and Perimeter

A = # of gray pixels

L = # of white pixels

Height and width of $\mathfrak{R}$

$$h = i_{max} - i_{min} + 1$$

$$w = j_{max} - j_{min} + 1$$

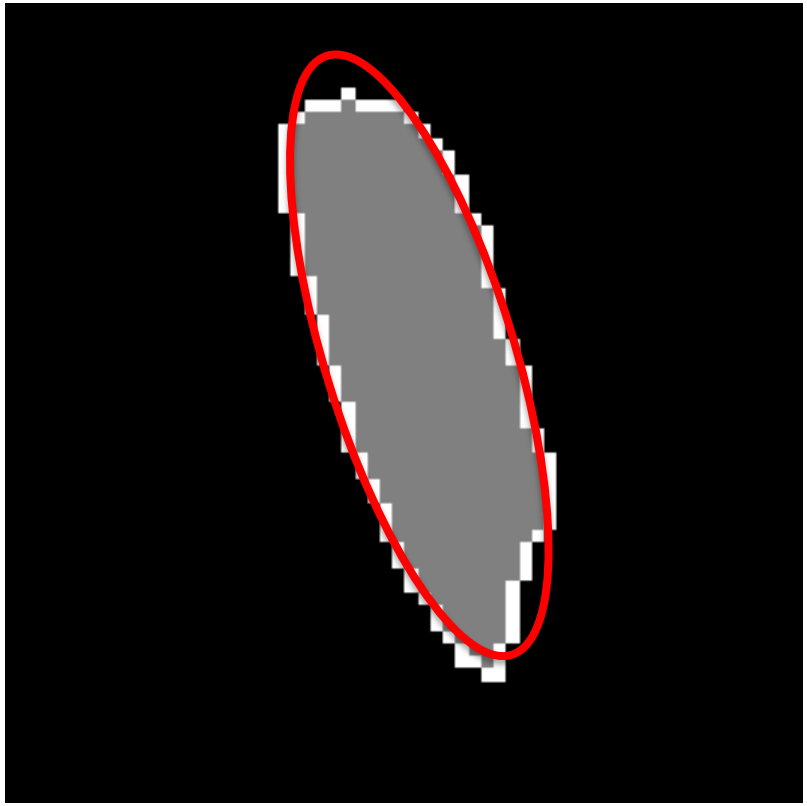
Roundness

$$R = \frac{4 \cdot A \cdot \pi}{L^2}$$

Center of Mass

(i_m, j_m)

Ellipses



Ellipses

Major axis (a)

Minor axis (b)

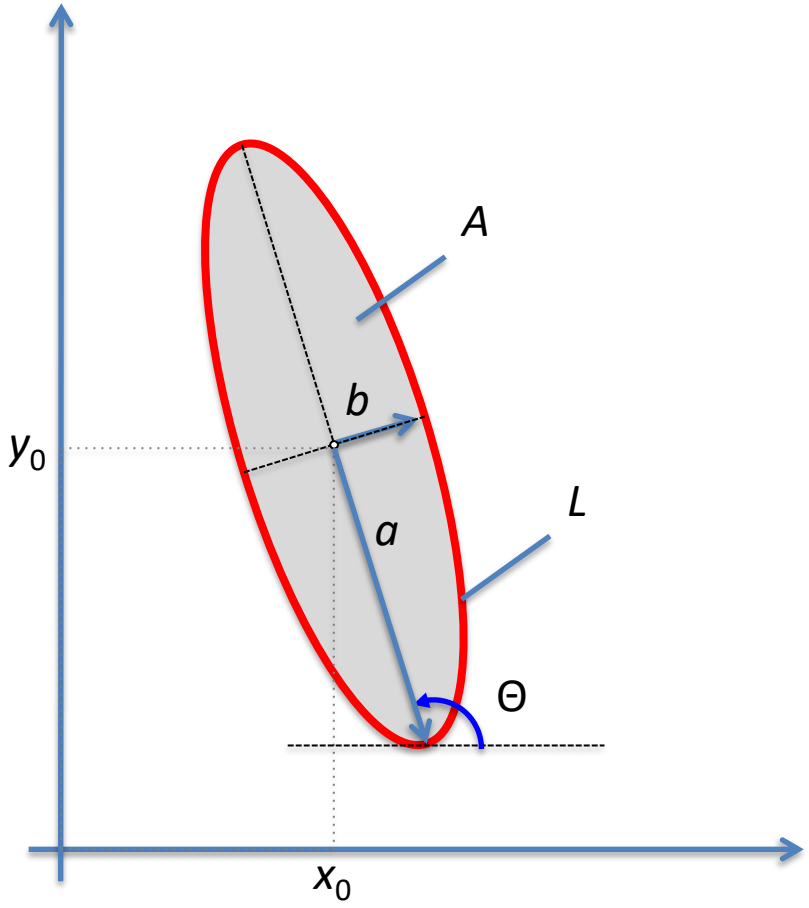
Orientation (Θ)

Center x_0, y_0

Area A

Perimeter L

Eccentricity $E = b/a$



Moments

$$m_{rs} = \sum_{i,j \in \Re} i^r j^s \qquad \text{for } r, s \in \mathcal{N}$$

$$\bar{i} = \frac{m_{10}}{m_{00}} \qquad \bar{j} = \frac{m_{01}}{m_{00}}$$

$$\mu_{rs} = \sum_{i,j \in \Re} (i - \bar{i})^r (j - \bar{j})^s \qquad \text{for } r, s \in \mathcal{N}$$

Hu - Moments

They are invariant against:

- scale,
- rotation and
- location

$$
\begin{aligned}
\phi_1 &= \eta_{20} + \eta_{02} \\
\phi_2 &= (\eta_{20} - \eta_{02})^2 + 4\eta_{11}^2 \\
\phi_3 &= (\eta_{30} - 3\eta_{12})^2 + (3\eta_{21} - \eta_{03})^2 \\
\phi_4 &= (\eta_{30} + \eta_{12})^2 + (\eta_{21} + \eta_{03})^2 \\
\phi_5 &= (\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] + \\
&\quad (3\eta_{21} - \eta_{03})(\eta_{21} + \eta_{03})[3(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2] \\
\phi_6 &= (\eta_{20} - \eta_{02})[(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2] + \\
&\quad 4\eta_{11}(\eta_{30} + \eta_{12})(\eta_{21} + \eta_{03}) \\
\phi_7 &= (3\eta_{21} - \eta_{03})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] - \\
&\quad (\eta_{30} - 3\eta_{12})(\eta_{21} + \eta_{03})[3(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2]
\end{aligned}
$$

with

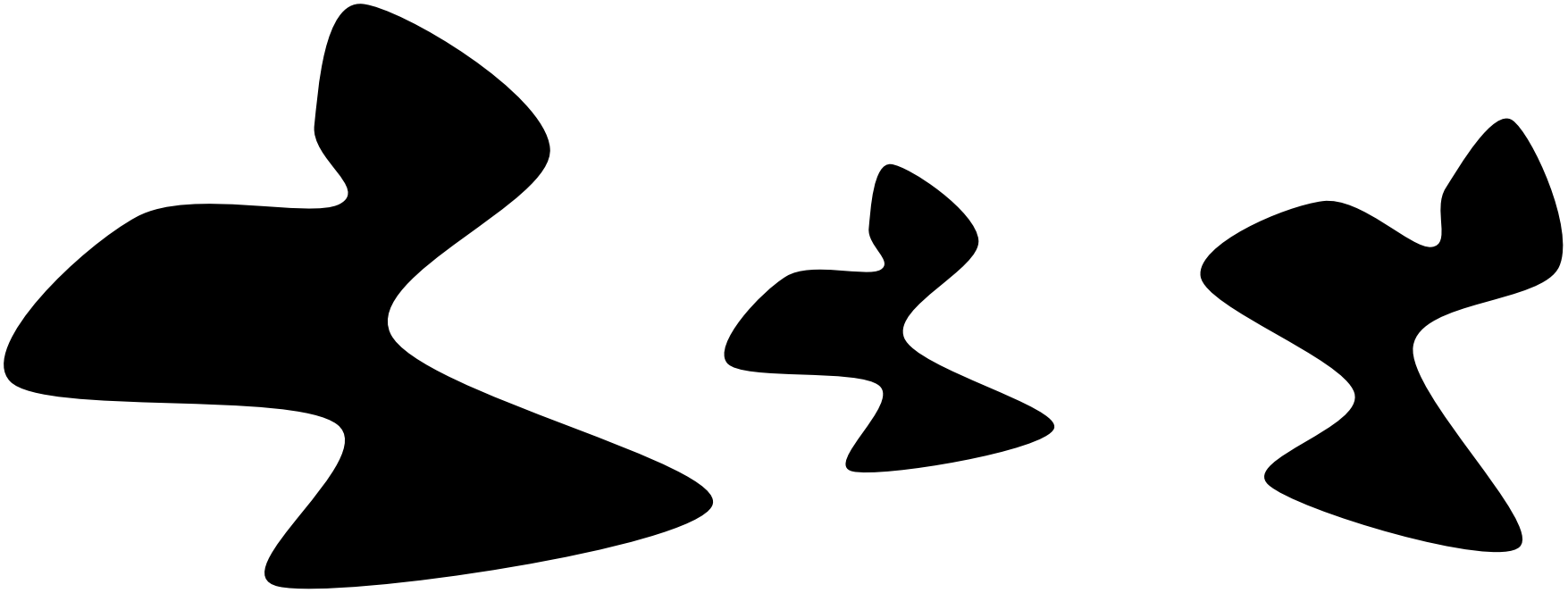
$$\eta_{rs} = \frac{\mu_{rs}}{\mu_{00}^t} \qquad t = \frac{r+s}{2} + 1.$$

Hu, M.K. (1962): Visual Pattern Recognition by moment invariants. IRE Trans. On Information Theory, 8(2): 179-187.

Hu - Moments

They are invariant against:

- scale,
- rotation and
- location



They have similar Φ_1, Φ_2, … Φ_7.

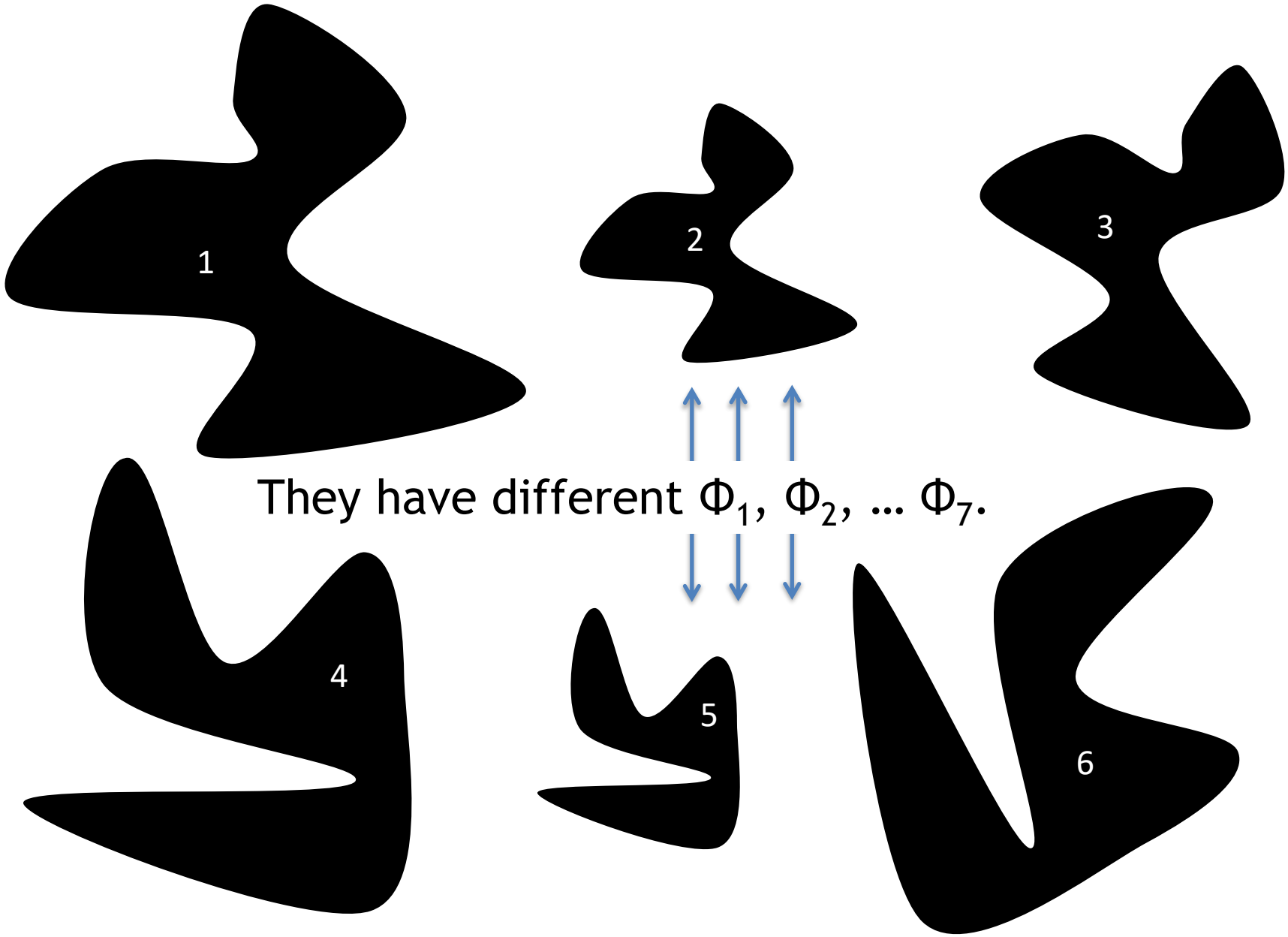
Hu - Moments

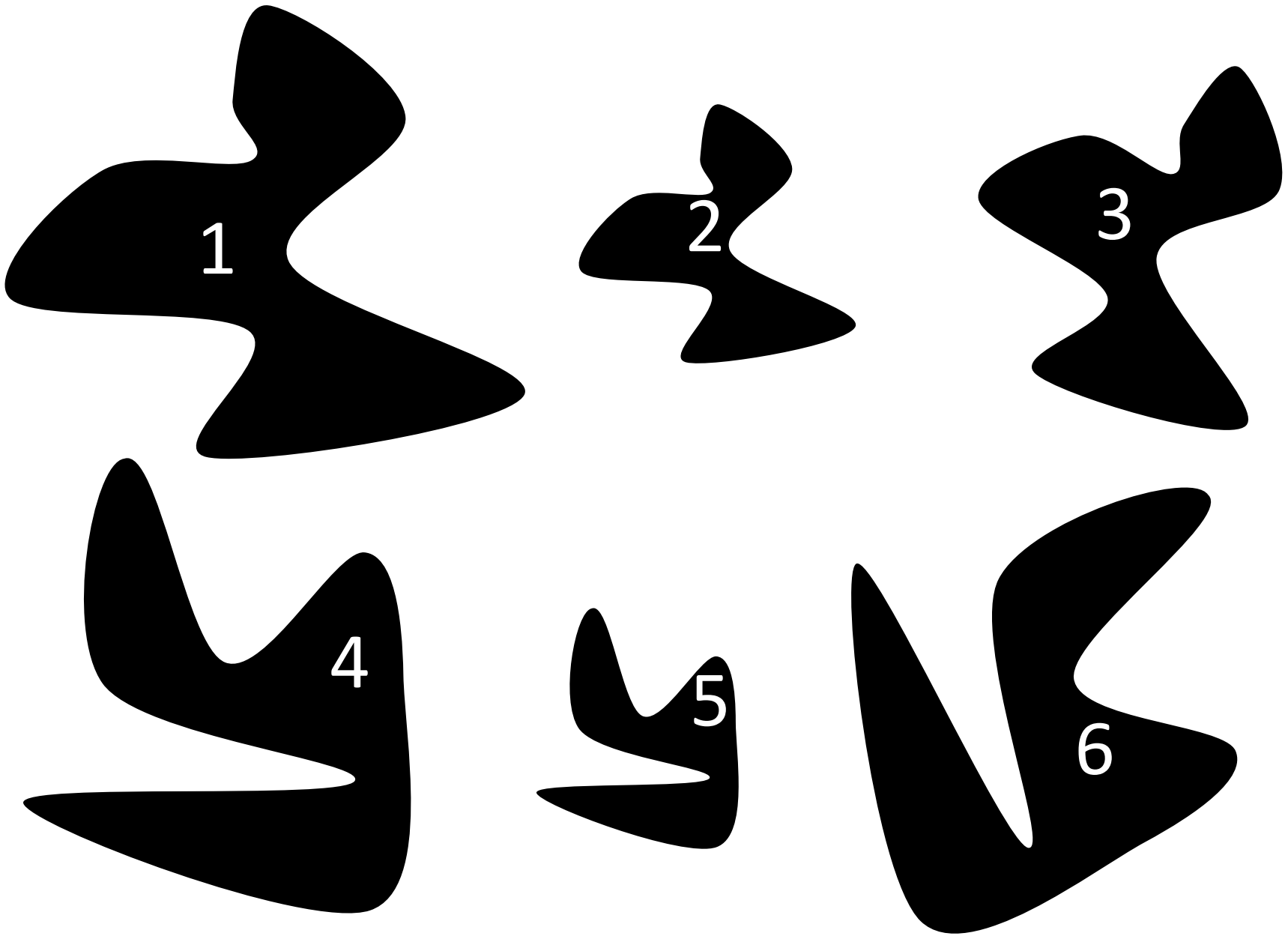
They are invariant against:

- scale,
- rotation and
- location

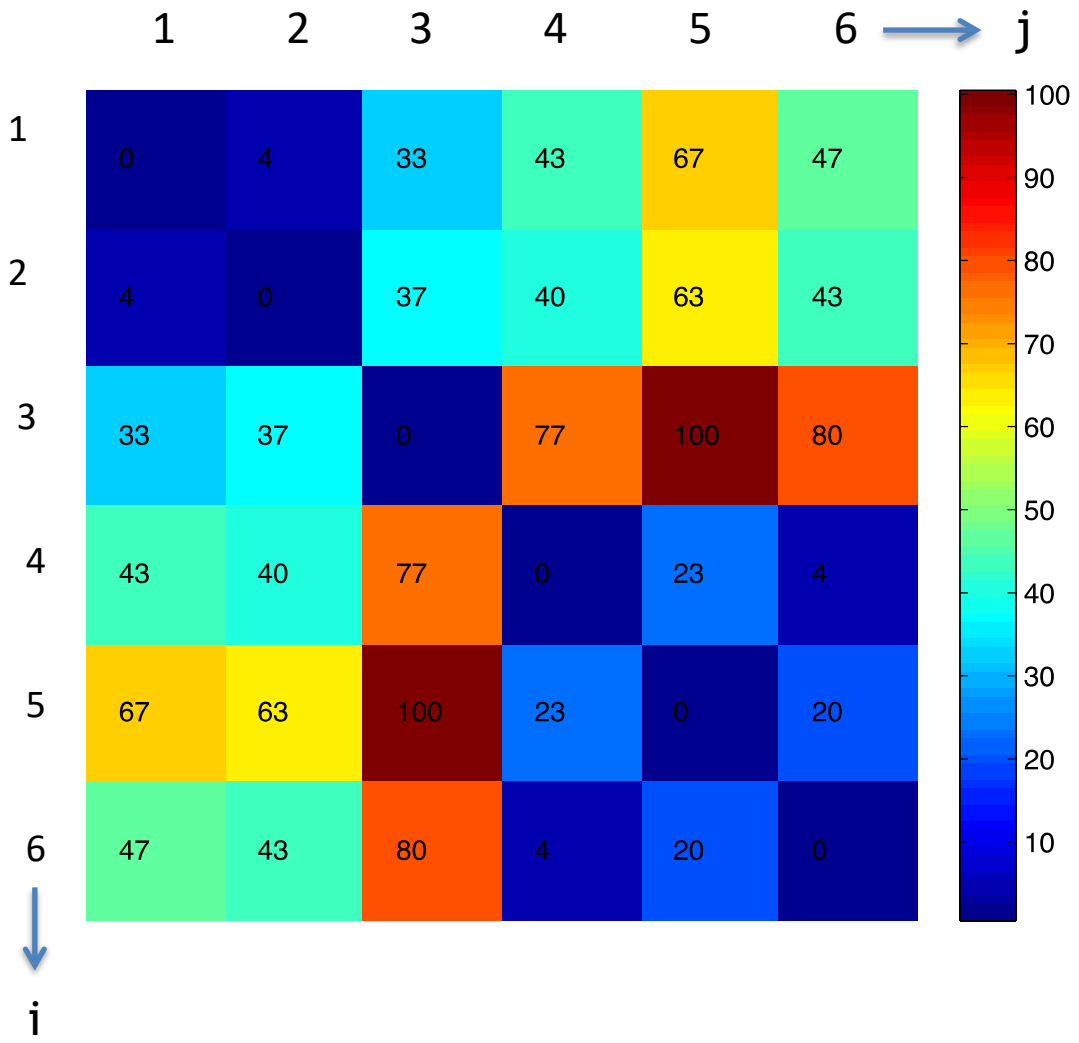
They have similar Φ_1, Φ_2, … Φ_7.

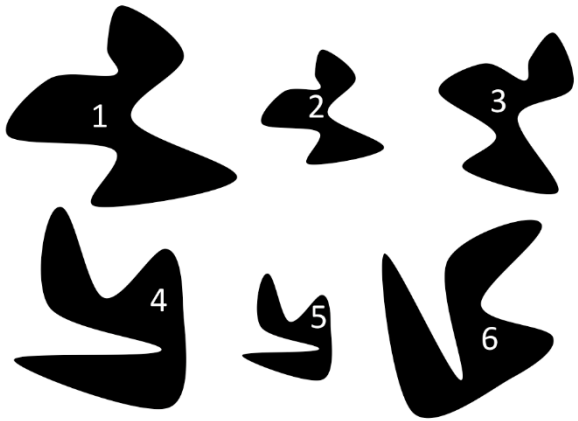
Hu - Moments



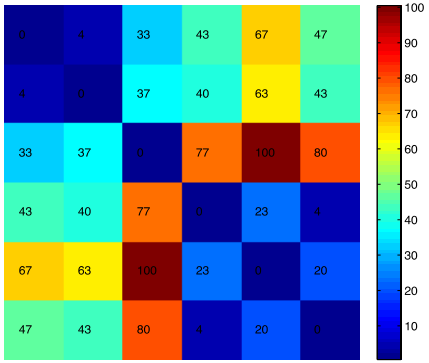

1
2
3
4
5
6

Difference between Φ_1 of region i and Φ_1 of region j

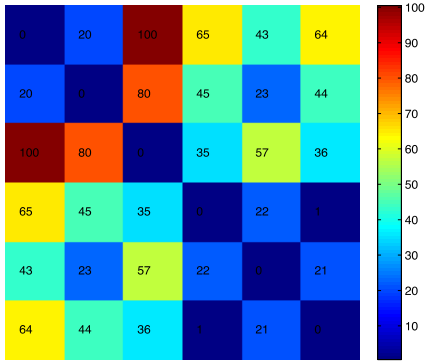




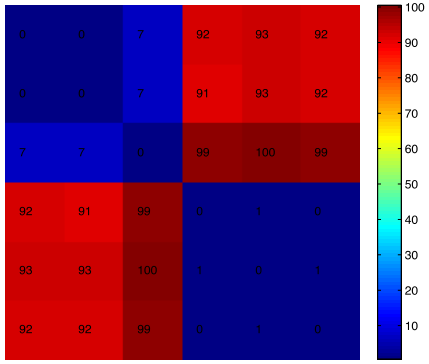
Φ_1



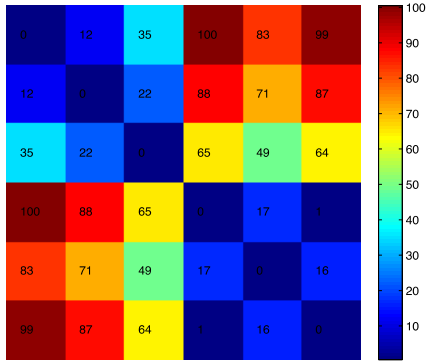
Φ_2



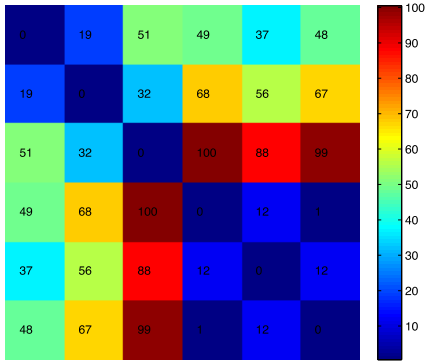
Φ_3



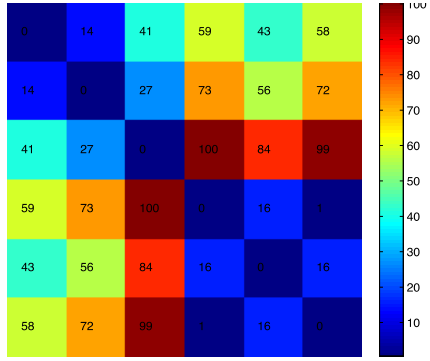
Φ_4



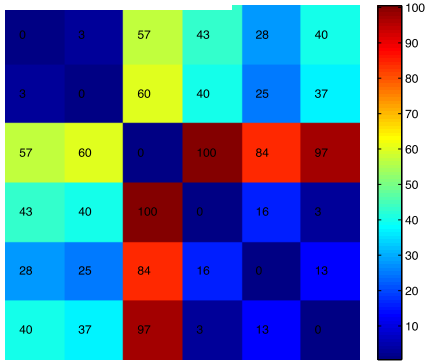
Φ_5



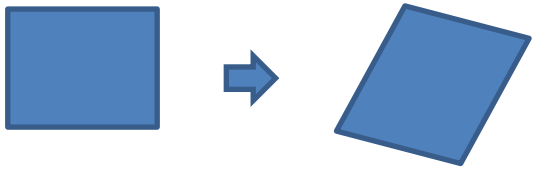
Φ_6



Φ_7



Flusser Moments



Invariante a la transformada afín: líneas paralelas se transforman como líneas paralelas

$$I_1 = \frac{\mu_{20}\mu_{02} - \mu_{11}^2}{\mu_{00}^4}$$

$$I_2 = \frac{\mu_{30}^2\mu_{03}^2 - 6\mu_{30}\mu_{21}\mu_{12}\mu_{03} + 4\mu_{30}\mu_{12}^3 + 4\mu_{21}^3\mu_{03} - 3\mu_{21}^2\mu_{12}^2}{\mu_{00}^{10}}$$

$$I_3 = \frac{\mu_{20}(\mu_{21}\mu_{03} - \mu_{12}^2) - \mu_{11}(\mu_{30}\mu_{03} - \mu_{21}\mu_{12}) + \mu_{02}(\mu_{30}\mu_{12} - \mu_{21}^2)}{\mu_{00}^7}$$

$$\begin{aligned} I_4 = \quad & (\mu_{20}^3\mu_{03}^2 - 6\mu_{20}^2\mu_{11}\mu_{12}\mu_{03} - 6\mu_{20}^2\mu_{02}\mu_{21}\mu_{03} + 9\mu_{20}^2\mu_{02}\mu_{12}^2 \\ & + 12\mu_{20}\mu_{11}^2\mu_{21}\mu_{03} + 6\mu_{20}\mu_{11}\mu_{02}\mu_{30}\mu_{03} - 18\mu_{20}\mu_{11}\mu_{02}\mu_{21}\mu_{12} \\ & - 8\mu_{11}^3\mu_{30}\mu_{03} - 6\mu_{20}\mu_{02}^2\mu_{30}\mu_{12} + 9\mu_{20}\mu_{02}^2\mu_{21} \\ & + 12\mu_{11}^2\mu_{02}\mu_{30}\mu_{12} - 6\mu_{11}\mu_{02}^2\mu_{30}\mu_{21} + \mu_{02}^3\mu_{30}^2)/\mu_{00}^{11} \end{aligned}$$

Flusser, J., & Suk, T. (1993). Pattern recognition by affine moment invariants. Pattern recognition, 26(1), 167-174.